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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Forecasted deep stratospheric intrusions over Central Europe: case studies and climatologies" *by* T. Trickl et al.

Anonymous Referee #2

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Review of "Forecasted deep stratospheric intrusions over central Europe: case studies and climatologies" by T. Trickl et al:

General Comment:

The article presents ground based ozone lidar measurements of stratospheric intrusions over southern Germany during an intensive observation period from February-August 2001. This data set in conjunction with two Lagrangian models is used to classify the intrusions according to their transport history and assign typical signatures of intrusion air-masses to ozone and Be7 measurements at the nearby Zugspitze summit. Then, a five-year climatology of stratospheric intrusions is derived based on daily trajectory model forecasts, available during several European projects. The work ad-

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Interactive Discussion
Discussion Paper

dresses highly topical questions, uses adequate state-of-the-art instrumentation and tools and it reaches substantial conclusions about the frequency of stratospheric intrusions, their annual occurrence frequency and their relevance for the tropospheric ozone budget. Some discussions are, however, avoidable extensive while other issues should be discussed in some more detail. Few of the results shown in this study have already been published before but different scientific questions were addressed in these papers. I therefore support the publication of the article after the following questions and comments have been taken into account.

Scientific questions/issues:

1) Models: The use of different trajectory codes based on different meteorological data and the authors’ expertise definitely is a strength of this study. Therefore the agreement/difference between the different models’ trajectories should be discussed in more detail, particularly for the classified transport pathways to prove that they are really significantly different. My feeling is that half the number of classes would do, because the processes are very similar and seemly do not lead to different signatures in the observations at the mountain station.

The FLEXPART model is run for up to 20 days in retroplume mode. Has it been proven, that the results so far back are still believable or are there strong arguments for this? Do these simulations allow statements about residence of the intruded air in the troposphere?

The EURAD model is operated below the resolution of the ECMWF (about 50 km by that time) and well below the one feasible by TM5. Does this aid the analysis? – I would expect an equivalent or even better representation of intrusions from operationally available ECMWF analyses or short term forecasts.

2) Cases studies: Section 3 describing the development/characteristics of individual intrusions should be less descriptive and more conclusive. Some discussion of individual cases beneficially illustrates the complex stirring vs. mixing processes inside

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intrusions but it should confine to those cases which actually represent one of the classified archetypes. The development of intrusions has been described several times before and is too manifold and specific to really add value to the scope of this paper.

3) Mixing: Though the discussion of mixing on p27+p28 is already well done, a stricter discrimination between (external) stirring and (internal) mixing would aid the understanding of questionable intrusion signature in the Zugspitze observations.

4) Representativity and transferabilty: These issues should be briefly discussed as they seem to be of general interest: Is your classification applicable to other European (mountain) sites or could you estimate a kind of validity radius? Which modifications would have to be considered? You don’t observe a trend in the frequency (sure 5 years are too short anyway) – does your model tell whether this is representative for the whole mid-Europe? What does crucially determine the frequency at Zugspitze – the position of the polar front? Do your classified types differ in the intrusion strength i.e. the amount of air transported from the stratosphere to the troposphere?

5) Zugspitze measurements: Can you explain why there is hardly any anticorrelation between ozone and CO during the intrusion events? I would have expected this different.

6) Can the uncertainty imposed by the smoothed model orography be quantified? Is there a strong difference between ECMWF and the NOAA data.

Technical issues:

P8, last section: tell by which meteo model data the HYSPLIT trajectories are driven – GDAS?, FNL?

P25: what is the benefit of distinguishing direct (young?) and indirect (older?) intrusions?

Fig 3: it would help the readability of the figures if you indicate the back-trajectories

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Interactive Comment

(from Zugspitze column) determining the class to which this intrusion is assigned

Use SI units: replace mbar by hPa

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 2223, 2009.